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NCSP Spring Newsletter

First NCSP Sponsored Experiment at LANSCE

Uranium-233 has played an important role in solution critical experiments going back to the 50's and 60's, including experiments from the Falstaff Program. More recently, management of legacy ^{233}U material across the DOE complex has led to a requirement for improved nuclear cross sections.

To meet the goals of the NCSP, initial measurements of the $^{233}\text{U}(n,\gamma)$ reaction data were made during December 2020 at the Los Alamos Neutron Science Center (LANSCE) at Los Alamos National Laboratory (LANL) using the Detector for Advanced Neutron Capture Experiments (DANCE) combined with the NEutron detector array at dANCE (NEUANCE).

Because ^{233}U fission is around one order of magnitude more likely than capture, accurate measurement of the ^{233}U capture cross section relies on the discrimination between the gammas produced in capture and fission reactions. This discrimination method requires the use of an experimental setup combining capture and fission detectors. In this measurement, NEUANCE tagged fission neutrons while DANCE detected both capture and fission gammas. Coincidences between NEUANCE and DANCE are reconstructed during analysis.



Figure 1: Esther Leal Cidoncha (NCSP-funded postdoctoral fellow in P-3) working on DANCE.

This measurement will provide cross section data in the Resonance Region (RR), with a focus in the keV neutron energy Unresolved Resonance Region (URR). NEUANCE offers excellent separation between fission neutrons and gamma-rays via pulse shape discrimination. A major advantage of this neutron tagging technique is that it allows use of relatively thick samples ($>50 \text{ mg/cm}^2$). While the fission products are trapped in the sample, the fission neutrons escape to the NEUANCE detectors unimpeded. As a result, the measurement time is greatly reduced. Thirty milligrams of high purity (99.98 %) ^{233}U was purchased from the National Isotope Development Center (NIDC) for the measurement. The material was fabricated into two samples, one of 20 mg and one of 10 mg.

Analysis of the data from the December experiments is in process. The preliminary raw counts before subtraction of the fission gammas is shown in Figure 2 for a small percentage of the total counts obtained. In order to achieve enough statistics in the keV region the measurements will continue in June and July of 2021.

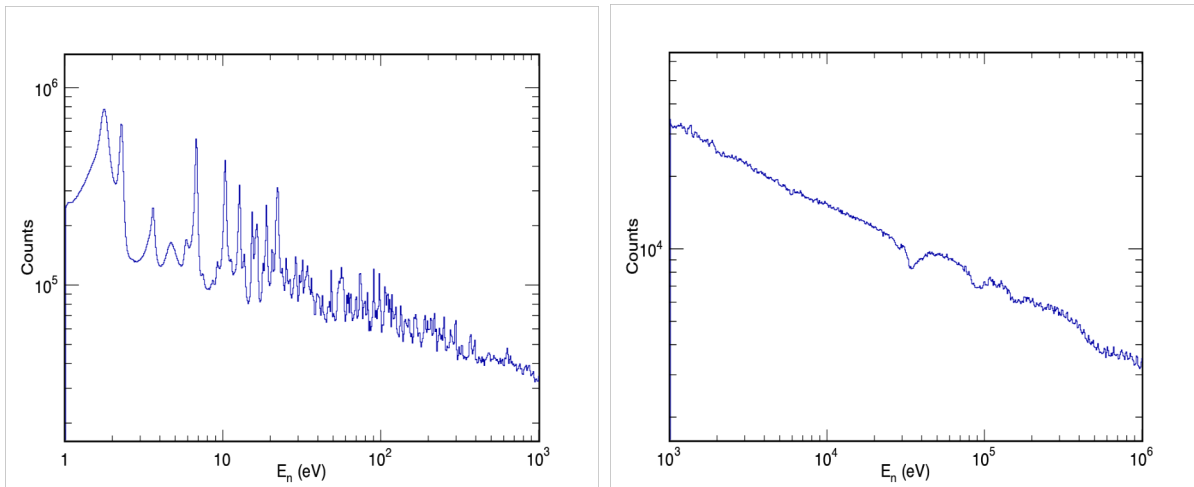


Figure 2: Preliminary raw ^{233}U counts before subtraction of the fission gammas. The Resolved Resonance Region (RRR) is shown in the figure on the left, and the Unresolved Resonance Region (URR) is shown in the figure on the right.